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Federal Aviation Agency

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**BOLT, BERANEK & NEWMAN, INC.**

**OCTOBER 1964**

**MAY 1965**

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## APPENDIX A

This Appendix presents perceived noise level contours for the takeoff and landing operations of the following types of civil aircraft:

- a) two and three engine, short and medium range turbojet and turbofan transports
- b) multi-engine small business turbojet and turbofan aircraft
- c) two-engine piston and turboprop aircraft, both transport and business.

These contours permit the determination of the noise level in PNdB over a wide area beneath and off to the side of a flight path. The Appendix also includes a runup noise contour for estimating the noise from ground runups of civil and military turbofan engines.

The noise contours for flight operations supplement the noise contours given in Attachment 2 of the report "Land Use Planning Relating to Aircraft Noise" issued by the FAA as a Technical Report of Bolt Beranek and Newman Inc. in October 1964.\* The runup noise contour (Contour Set 12) replaces Contour Set 7 of Attachment 2; it is based upon a more extensive range of turbofan engines than Contour Set 7. The noise contours are to be used in the same manner as those in Attachment 2 following exactly the same procedures outlined in the referenced report.

By providing noise estimates for a variety of smaller and more recent aircraft not included in Attachment 2, this Appendix should extend the usefulness of the referenced report as a land use planning aid at both large and small airports. The noise contours may also prove useful in determining aircraft noise compatibility for varied land uses, other than residential, following the procedures outlined in Part II of the Federal Aviation Agency SRDS Report No. RD-64-148.

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\* This report has also been published by the Department of Defense as a Tri-Service Manual "Land Use Planning With Respect to Aircraft Noise" given the following designations: AFM 86-5, TM 5-365 and Navdocks P-98.

The appropriate contour for a specific problem can be selected by reference to Table A-I. This table shows, for different aircraft, the appropriate takeoff, landing, or ground runup contour to be used and the appropriate perceived noise level correction needed for the particular contour.

Two sets of landing contours are listed in Table A-I for each type of aircraft. Contour Set 10, based upon a 3° glide slope, should normally be used for estimating noise levels in the vicinity of airports served by scheduled commercial aircraft and in the vicinity of all runways equipped for instrument landings. Contour Set 11, based upon an approach path appreciably higher than 3°, may be used for estimating the noise due to landing operations at airports not served by scheduled commercial aircraft and not possessing instrument landing facilities. Contour Set 10 provides a higher estimate of noise levels at distances more than several thousand feet from the runway threshold.

Figures A-1, A-2, A-3 and A-4 present the generalized perceived noise level-vs-distance and flight profile information upon which Contour Sets 9, 10 and 11 are based. This information supplements the generalized curves given in Attachment 3.

Figure A-1 shows two curves depicting the variation of perceived noise level with distance for medium and short range jet transport and business jet aircraft. These curves were used in constructing Contour Sets 9A, 10A and 11A. One curve is for takeoff power, the other for approach power. The curves apply directly to the Boeing 727 and Douglas DC-9 aircraft. Perceived noise level corrections for other transport and business aircraft are listed in the figure.

Figure A-2 shows generalized perceived noise level versus distance curves for two-engine piston and turboprop aircraft. These curves were used in constructing Contour Sets 9B, 10B and 11B. The upper curve describes the noise output at MTO power for two-engine piston transport aircraft such as the Douglas DC-3, Convair 340 and Martin 404. The middle curve describes the noise output at

takeoff power for two-engine turboprop transports (Fairchild F-27 and Grumman Gulfstream). The lower curve is for approach power for two-engine piston and turboprop transport aircraft. As noted in the figure, a correction of -10 PNdB should be applied to the upper and lower curves of Figure A-2 for estimates of the noise output of two-engine light piston business aircraft.

Figure A-3 shows the takeoff profile used in constructing Contour Set 9A. The boundaries of the shaded area shown in the figure represent the range of takeoff profiles at maximum gross weight and at approximately 85% gross weight under standard day, no wind conditions for two and three engine, small and medium range jet transport aircraft. These boundaries also depict the range of corresponding takeoff profiles for most multi-engine business jet aircraft. The generalized takeoff profile line shown in the figure was drawn through the shaded area in such a manner that, at any given distance from the start of takeoff roll, the variation in altitude and above and below the profile line would produce the same change in perceived noise level.

Figure A-4 shows the generalized takeoff profile used in construction of Contour Set 9B for propeller aircraft. The shaded area represents the approximate range in expected profiles for two-engine piston and turboprop aircraft.

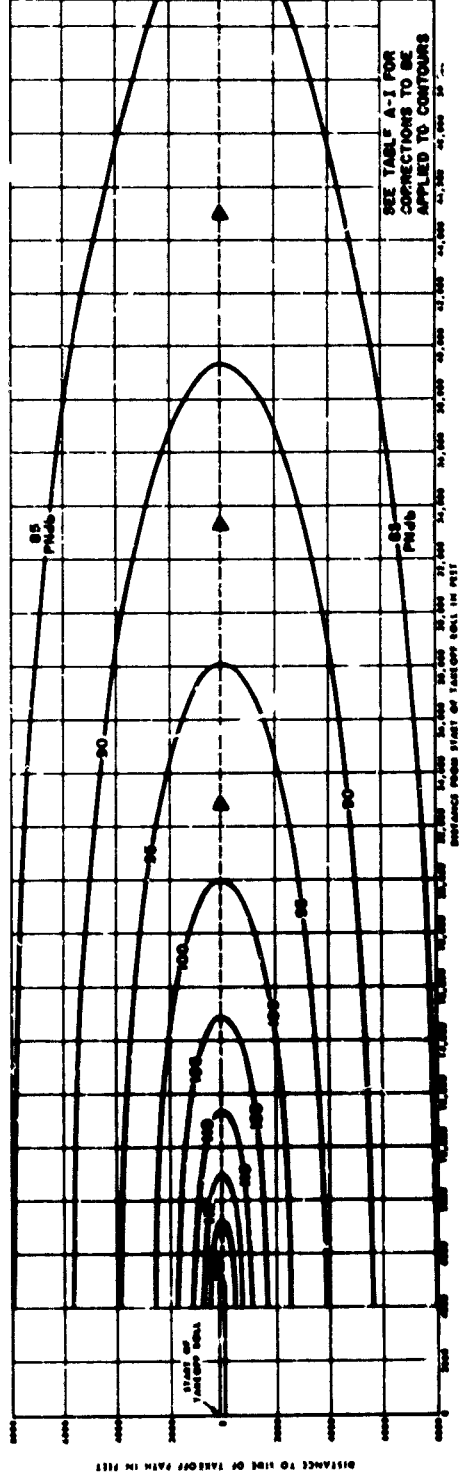
The landing profile used in preparing Contour Set 10 is based on a  $3^\circ$  glide slope, shown in Fig. 3-8 of Attachment 3. This landing profile is applicable to instrument landings (GCA and ILS) at civil airports and military air bases. In preparing Contour Set 11, applicable for VFR aircraft landings, a glide slope of  $4\frac{1}{2}^\circ$  was used. This glide slope forms the upper boundary of the shaded area shown in Fig. 3-8 of Attachment 3.

TABLE A-I  
CHART FOR SELECTING NOISE CONTOURS

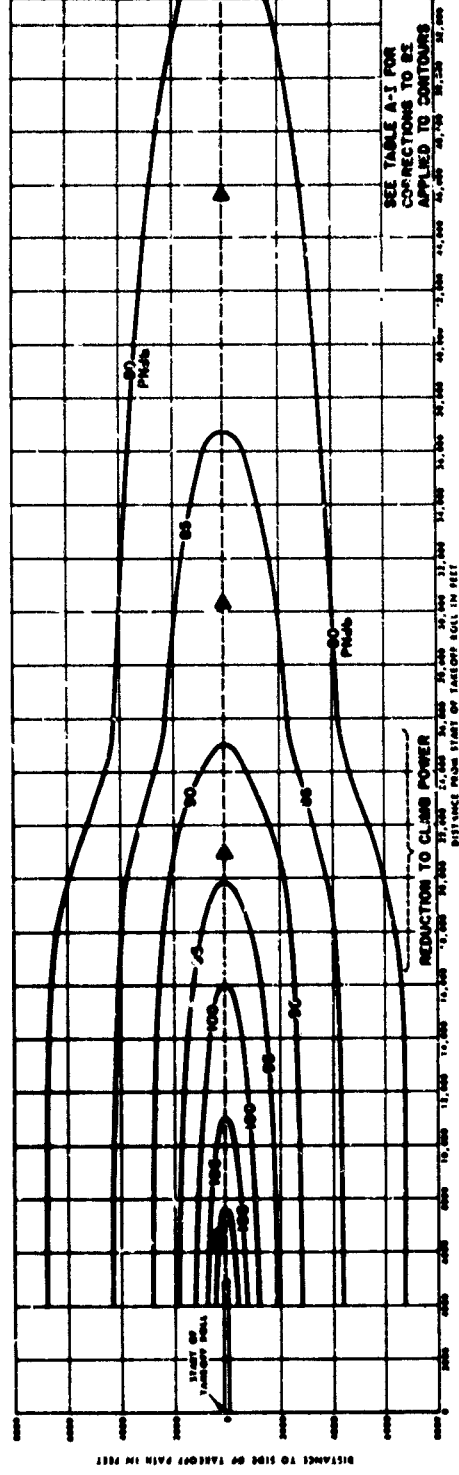
AIRCRAFT TYPE	OPERATION					
	TAKEOFFS		LANDINGS		RUNUPS	
	Contour Set	Corrections to Contour	Contour Set*	Corrections to Contour	Contour Set	Corrections to Contour
Medium and Short Range Turbofan Transports	Boeing 727, Douglas DC-9	0	10A	0	12	0
	BAC 1-11	+5 FNdB	10A	-5 FNdB	-	-
Medium Range Turbojet Transports	Caravelle (3 and 6 series)		10A	0	6	0
Business Turbojets	Jet Commander 1121, Lear Jet 23		10A	-5 FNdB	8	0
	Boeing 727, D.H. 125	0	10A	-10 FNdB	8	-5 FNdB
	Lockheed Jet Star North American Sabreliner		10A	-10 FNdB	12	-10 FNdB
Business Turbofans	Dassault Falcon	-5 FNdB	10A	-10 FNdB	X	
Two Engine Piston Transports	Douglas DC-3, 340, 440, Convair 440, Martin 404	0	10B	-0		
	Fairchild F-27, Grumman Gulfstream	-5 FNdB	10B	0		
Two Engine Light Piston Business Aircraft**	Aero Commander, Beech 18 series, Cessna 310 series, Piper Apache and Astec, etc.	-10 FNdB	10B	-10 FNdB		

\* Contour Set 11 may be used instead of Contour Set 10 for estimating noise exposure at airports not possessing instrument landing facilities or where only a very small proportion of instrument approaches are made.

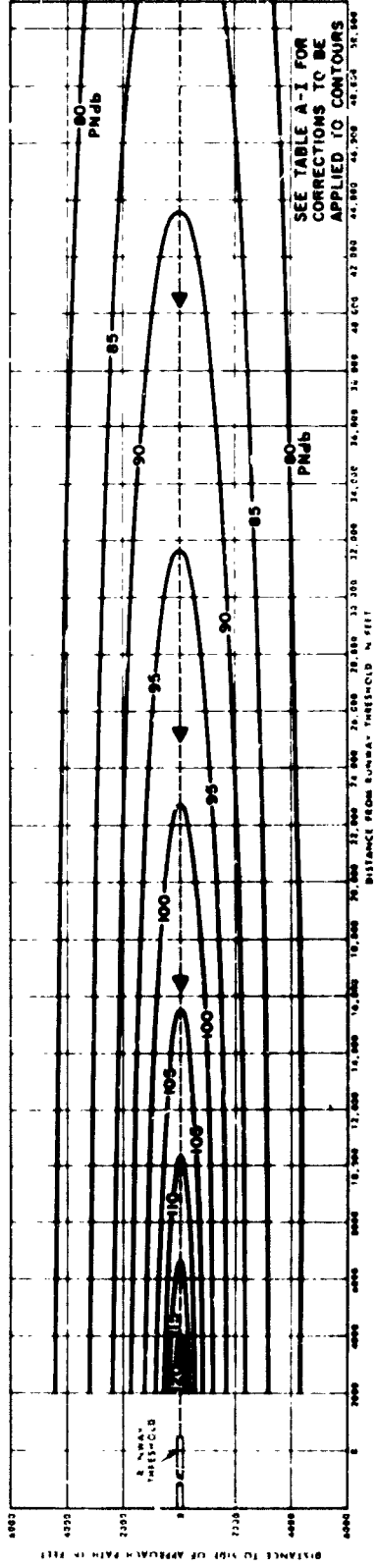
\*\* Two engine piston aircraft from 3,500 to 10,000 lbs gross weight.



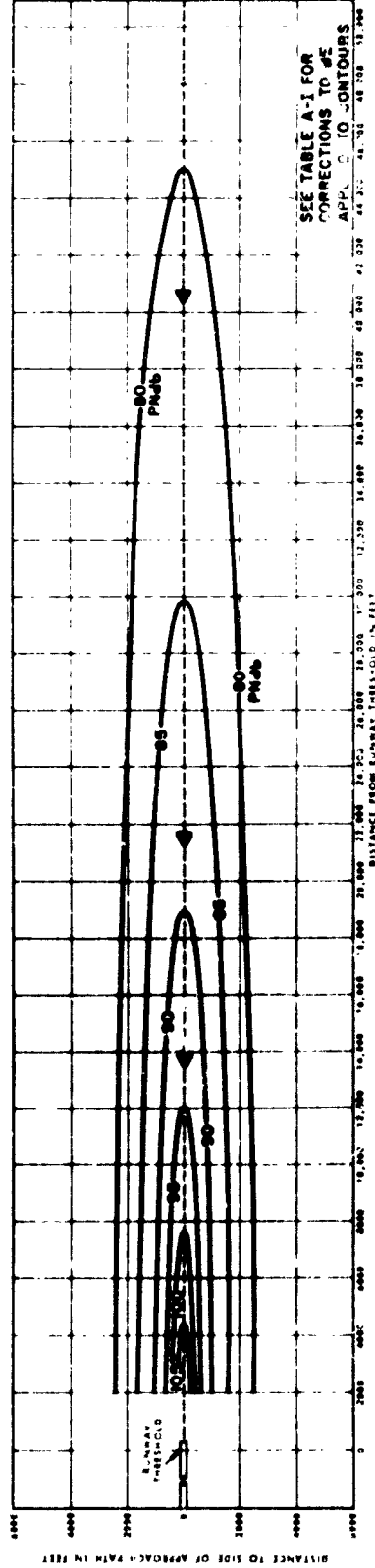
① MEDIUM AND SHORT RANGE JET TRANSPORT AND BUSINESS JET AIRCRAFT



② TWO ENGINE PROPELLER TRANSPORT AND BUSINESS AIRCRAFT  
PERCEIVED NOISE LEVEL CONTOURS FOR TAKEOFFS  
OF JET AND PROPELLER AIRCRAFT

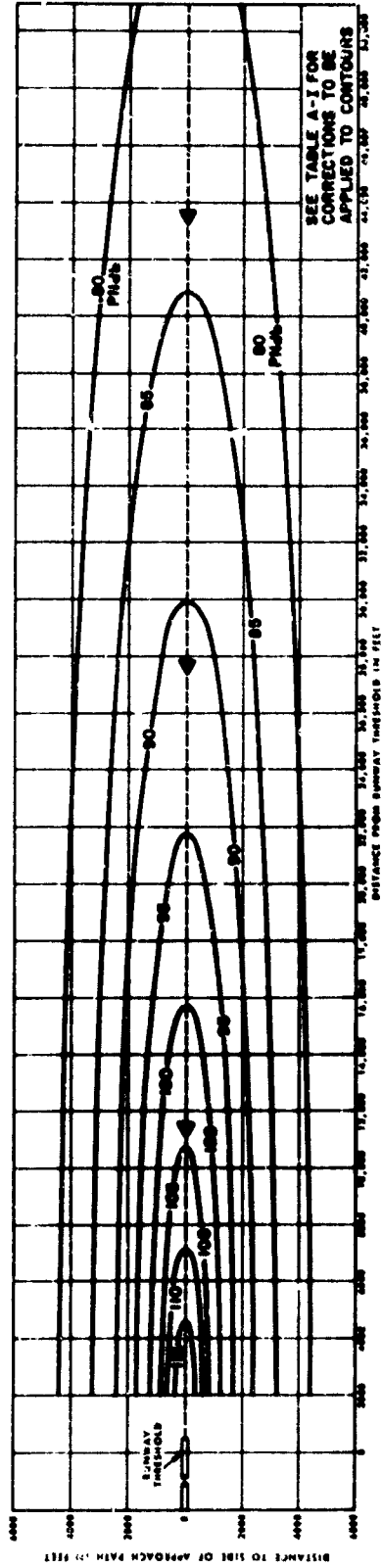


① MEDIUM AND SHORT RANGE JET TRANSPORT AND BUSINESS JET AIRCRAFT

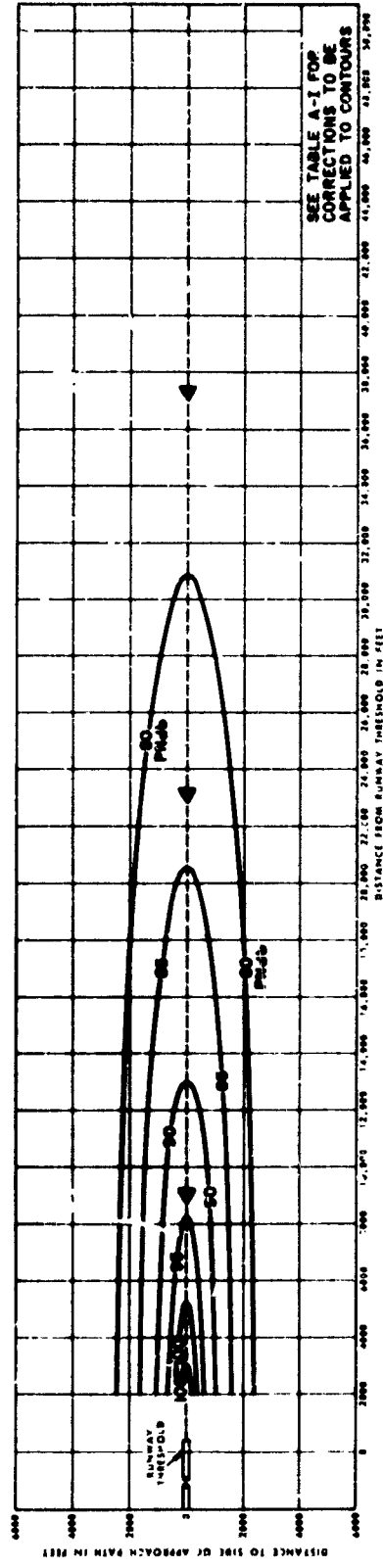


② TWO ENGINE PROPELLER TRANSPORT AND BUSINESS AIRCRAFT  
PERCEIVED NOISE LEVEL CONTOURS FOR INSTRUMENT  
LANDINGS OF JET AND PROPELLER AIRCRAFT

CONTOUR SET 10



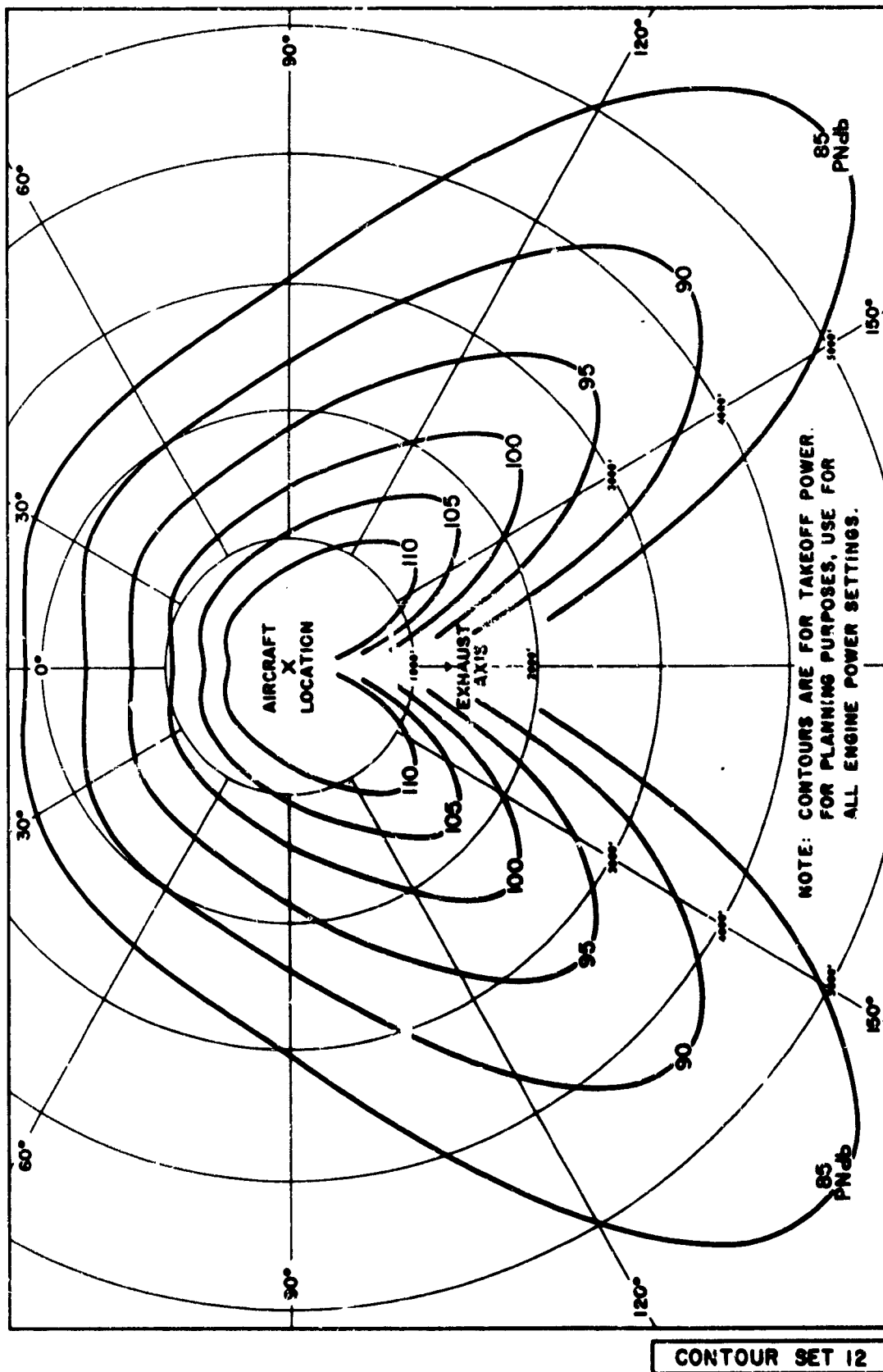
① MEDIUM AND SHORT RANGE JET TRANSPORT AND BUSINESS JET AIRCRAFT



② TWO ENGINE PROPELLER TRANSPORT AND BUSINESS AIRCRAFT  
PERCEIVED NOISE LEVEL CONTOURS FOR VFR AIRCRAFT  
LANDINGS OF JET AND PROPELLER AIRCRAFT

CONTOUR SET II





PERCEIVED NOISE LEVEL CONTOURS - ONE ENGINE RUNUPS  
CIVIL AND MILITARY JET AIRCRAFT WITH TURBOFAN ENGINES

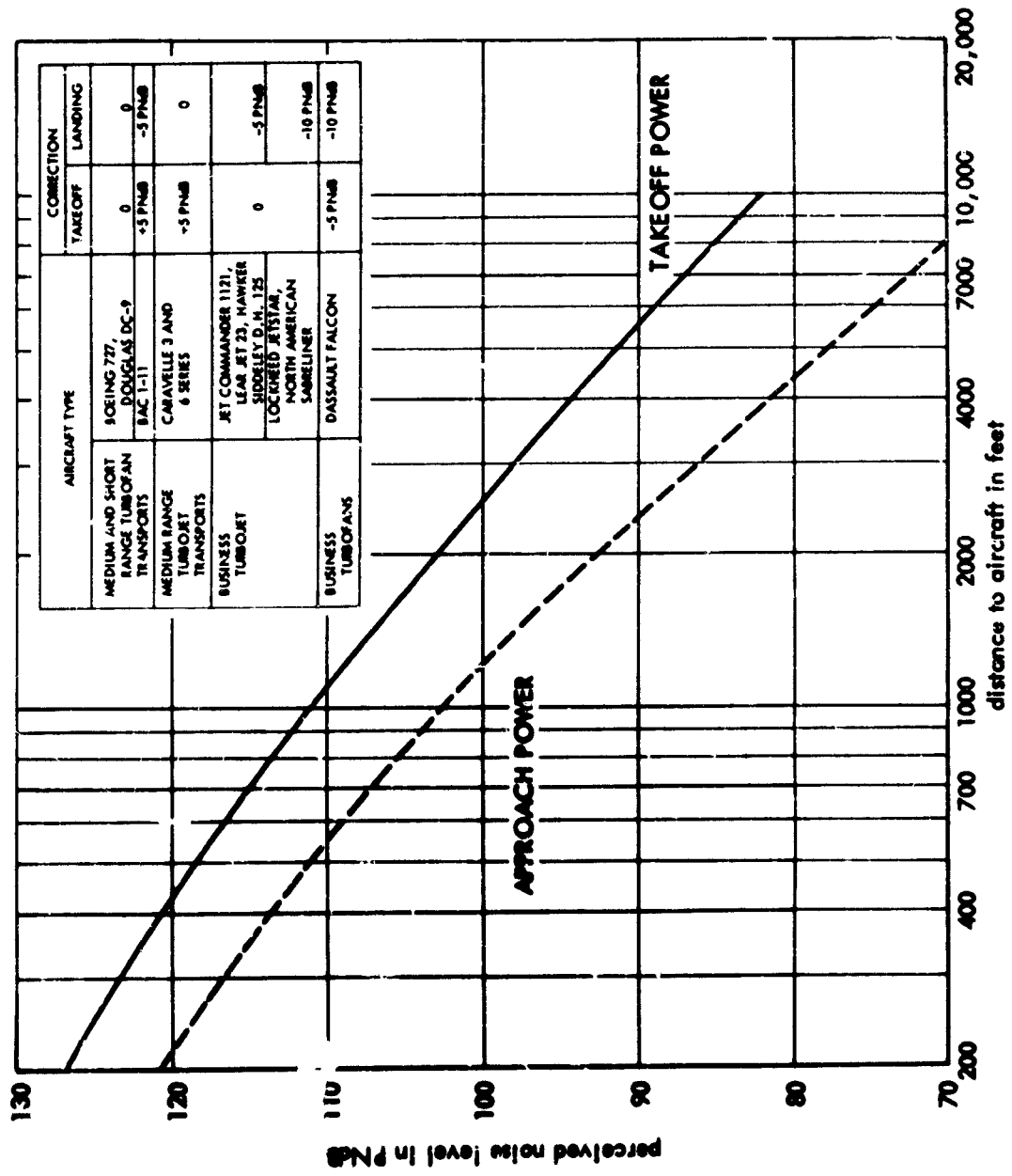


FIGURE A-1. GENERALIZED VARIATION OF PERCEIVED NOISE LEVEL WITH DISTANCE FOR CIVIL MEDIUM AND SHORT RANGE JET TRANSPORT AND BUSINESS JET AIRCRAFT

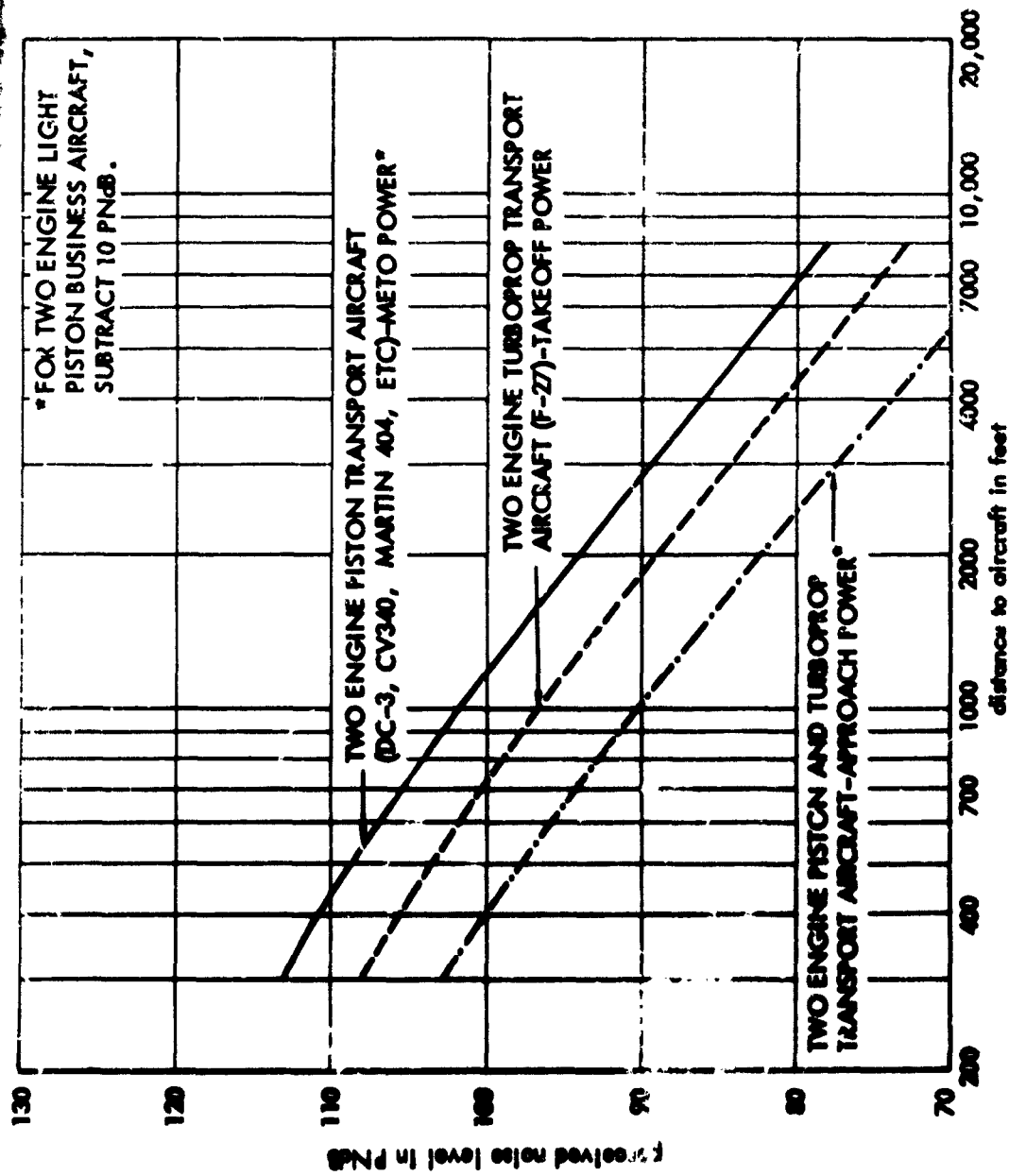


FIGURE A-2. GENERALIZED VARIATION OF PERCEIVED NOISE LEVEL WITH DISTANCE FOR TWO ENGINE PROPELLER TRANSPORT AND BUSINESS AIRCRAFT

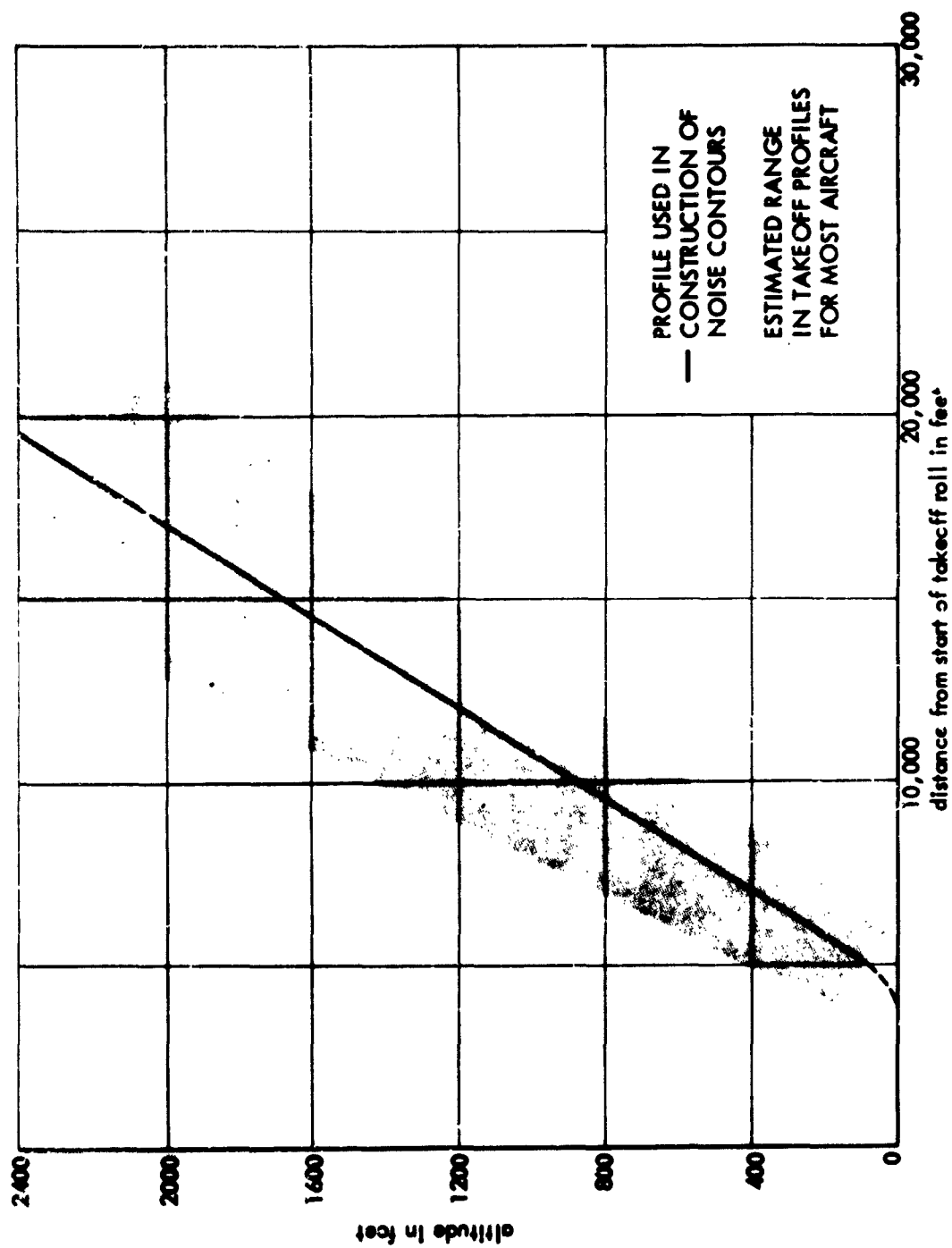


FIGURE A-3. GENERALIZED TAKEOFF PROFILE FOR MEDIUM AND SHORT RANGE JET TRANSPORT AIRCRAFT (BOEING 727, BAC 1-11, DOUGLAS DC-9, AND CARAVELLE SERIES 3 AND 6) AND BUSINESS JET AIRCRAFT

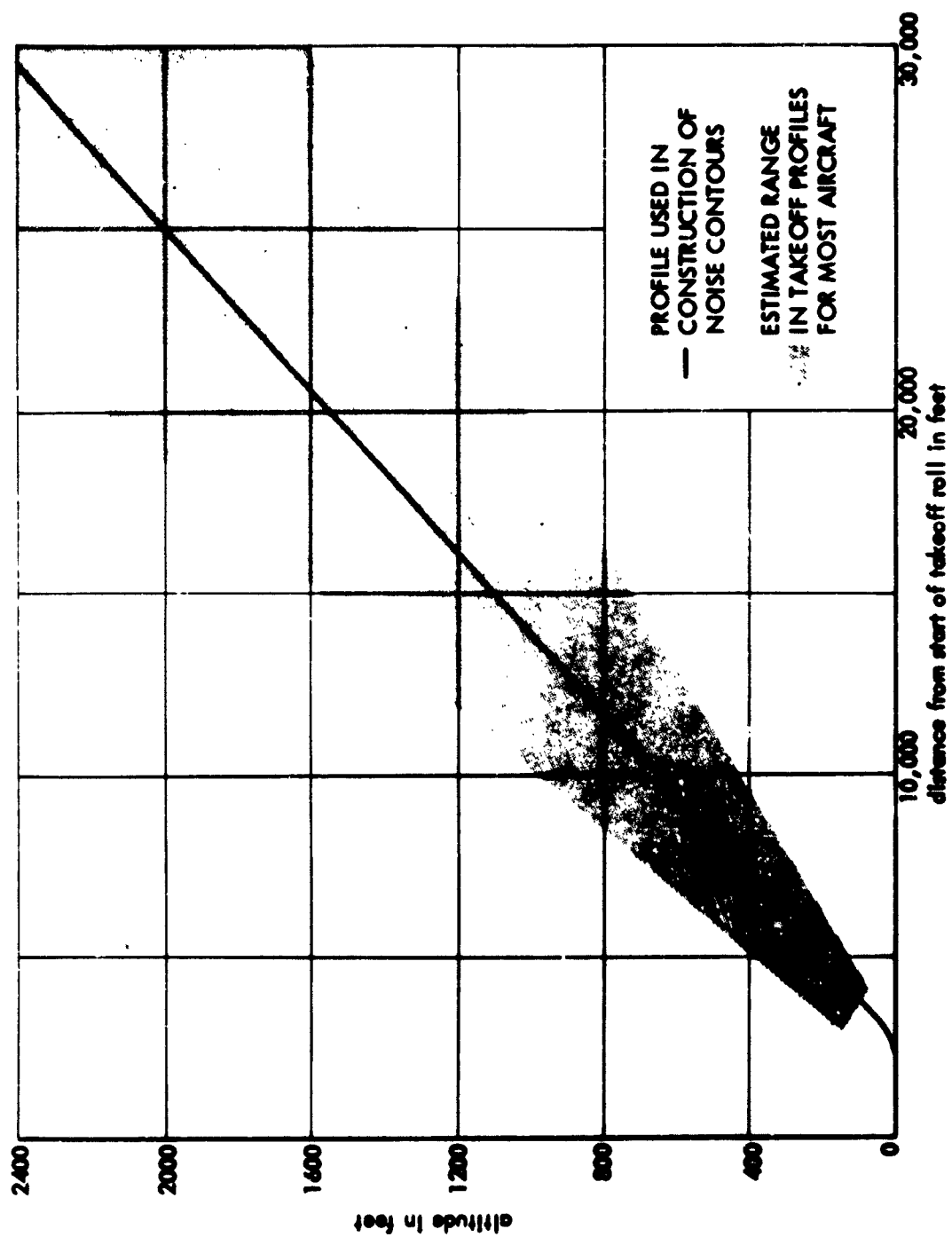


FIGURE A-4. GENERALIZED TAKEOFF PROFILE FOR TWO ENGINE PROPELLER TRANSPORT AND BUSINESS AIRCRAFT